

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/JP2004/019293

International filing date (day/month/year)
16.12.2004

Priority date (day/month/year)
24.12.2003

International Patent Classification (IPC) or both national classification and IPC
INV. H01M4/86 H01M4/94 H01M8/02 H01M8/04 H01M8/06 H01M8/10

Applicant
TOYOTA JIDOSHA KABUSHIKI KAISHA

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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this opinion

see form
PCT/ISA/210

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/JP2004/019293

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material:

- ☐ a sequence listing
- ☐ table(s) related to the sequence listing

b. format of material:

- ☐ on paper
- ☐ in electronic form

c. time of filing/furnishing:

- ☐ contained in the international application as filed.
- ☐ filed together with the international application in electronic form.
- ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has, within the applicable time limit:
- ☒ paid additional fees
 - ☐ paid additional fees under protest and, where applicable, the protest fee
 - ☐ paid additional fees under protest but the applicable protest fee was not paid
 - ☐ not paid additional fees
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
 - ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☒ all parts.
 - ☐ the parts relating to claims Nos.

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	2,5-9,11,14,15
	No: Claims	1,3,4,10,12,13
Inventive step (IS)	Yes: Claims	2,6-9,11
	No: Claims	1,3-5,10,12,13-15
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item IV

Lack of unity of invention

This Authority considers that there are 3 inventions covered by the claims indicated as follows:

(i) Claims 1-13

(i-1) Claims 1(part),2,3,10(part),12(part) and 13(part)

A fuel cell in accordance with claim 1,
wherein the temperature distribution equalizing portion comprises a shift catalyst portion, which is formed to be in contact with an anode inside said fuel cell and contains a shift catalyst of accelerating a shift reaction to produce hydrogen and carbon dioxide from carbon monoxide and steam, and the shift catalyst portion receives a supply of a reformed gas containing hydrogen, carbon monoxide, and steam and has a greater content of the shift catalyst in a specific region corresponding to a lower temperature area, which has a lower temperature than a remaining area due to either or both of the operating conditions of said fuel cell and the surroundings of said fuel cell, than a content of the shift catalyst in a residual region corresponding to the remaining area.

(i-2) Claims 1(part),4,5-9,10(part),11,12(part),13(part)

A fuel cell in accordance with claim 1,
wherein the temperature distribution equalizing portion controls heat generation in a higher temperature area having a higher temperature than a residual area, due to either or both of the operating conditions of said fuel cell and the surroundings of said fuel cell.

(ii) Claim 14

A fuel cell device (in accordance with claim 1),
wherein the temperature distribution equalizing portion comprises a first flow path and a second flow path to supply and discharge the reactive gas into and from said fuel cells; a first switchover element that is provided in the first flow path to make a switchover between

a gas intake state of allowing the reactive gas to be fed from a conduit connecting with the first flow path and to be introduced into said fuel cells and a gas discharge state of connecting the first flow path with outside to discharge the reactive gas flowed through said fuel cells to the outside; and a second switchover element that is provided in the second flow path to make a switchover between the gas intake state of allowing the reactive gas to be fed from a conduit connecting with the second flow path and to be introduced into said fuel cells and the gas discharge state of connecting the second flow path with the outside to discharge the reactive gas flowed through said fuel cells to the outside, wherein the first switchover element and the second switchover element are controlled to regulate the flow direction of the reactive gas passing through said fuel cells.

(iii) Claim 15

A fuel cell device (in accordance with claim 1),
wherein the temperature distribution equalizing portion comprises a reactive gas circulation module that recirculates at least part of a reactive gas exhaust, which is the reactive gas flowed through and discharged from said fuel cells, to the flow of the reactive gas; and a reactive gas temperature decreasing module that decreases temperature of the reactive gas exhaust, prior to recirculation of the reactive gas exhaust to the flow of the reactive gas.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

The subject-matter of independent claim 1 is already known from either one of the prior art documents D1 and D2 (see the grounds for this objection). The requisite unity of invention (Rule 13.1 PCT) therefore no longer exists inasmuch as a technical relationship involving one or more of the same or corresponding special technical features in the sense of Rule 13.2 PCT does not exist between the subject-matter of the following groups of dependent claims: (i-1) claims 1(part),2,3,10(part),12(part),13(part) and (i-2) claims 1(part),4,5-9,10(part),11,12(part),13(part).

A similar reasoning applies also to claims 14 and 15. Claims 14 and 15 comprise all the

features of claim 1 and are therefore not appropriately formulated as claims dependent on the latter (Rule 6.4 PCT).

In conclusion, the groups of claims are not linked by common or corresponding special technical features and define 3 different inventions not linked by a single general inventive concept.

The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

INVENTION I:

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1) Reference is made to the following documents:

D1: US-B1-6 444 339

D2: US-A-5 631 099

2) CLARITY:

2.1) The application does not meet the requirements of Article 6 PCT, because claim 1 is not clear.

2.2) The embodiments of the invention described in example 1 do not fall within the scope of the claims. This inconsistency between the claims and the description leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear, Article 6 PCT.

In the modified structure according to example 1 another catalyst layer of a noble metal or

a noble metal alloy may be formed between the hydrogen permeable metal layer and the electrolyte layer whereas claim 1 gives the impression that the electrolyte layer is formed directly on the hydrogen permeable metal layer.

2.3) Dependent claims 12 and 13 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.

3) NOVELTY:

3.1) The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1, 3, 4, 10, 12 and 13 is not new in the sense of Article 33(2) PCT.

3.2) Document D1 (column 26, line 57 - column 27, line 25; claim 1; the references in parentheses applying to this document) discloses:

A fuel cell having a hydrogen permeable metal layer that is formed on a plane of an electrolyte layer that has proton conductivity and includes a hydrogen permeable metal and further having another catalyst layer of a noble metal or a noble metal alloy formed between the hydrogen permeable metal layer and the electrolyte layer (column 26, line 57 - column 27, line 25), said fuel cell comprising:
a temperature distribution equalizing portion, e.g. a heat exchange portion (claim 1), to equalize an uneven temperature distribution in said fuel cell, wherein the uneven temperature distribution is caused by either or both of operating conditions of said fuel cell and surroundings of said fuel cell.

3.3) Likewise, document D2 (column 12, line 59 - column 13, line 2; claim 1-41; the references in parentheses applying to this document) discloses:

A fuel cell having a hydrogen permeable metal layer that is formed on a plane of an electrolyte layer that has proton conductivity and includes a hydrogen permeable metal and further having another catalyst layer of a noble metal or a noble metal alloy formed

between the hydrogen permeable metal layer and the electrolyte layer (claims 1,11), said fuel cell comprising:

a temperature distribution equalizing portion, e.g. a heat-removing condensing surface membrane (column 12, line 59 - column 13, line 2), to equalize an uneven temperature distribution in said fuel cell, wherein the uneven temperature distribution is caused by either or both of operating conditions of said fuel cell and surroundings of said fuel cell.

3.4) As such, the subject-matter of claim 1 insofar as this claim can be understood (cf. CLARITY; example 1), is disclosed by both documents D1 and D2 and is therefore considered to lack novelty.

Document D1 further discloses the subject-matter of dependent claims 3, 4, 10, 12 and 13. Document D2 further discloses the subject-matter of dependent claims 3, 4, 10 and 13.

4) INVENTIVE STEP:

4.1) Dependent claim 5 does not contain any features which, in combination with the features of any claim to which it refers, meet the requirements of the PCT in respect of inventive step (Article 33(2) and (3) PCT).

4.2) The combination of the features of dependent claims 2, 6-9 and 11 is neither known from, nor rendered obvious by, the available prior art.

INVENTION II:

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1) Reference is made to the following documents:

D1: US-B1-6 444 339

D2: US-A-5 631 099

D3: PATENT ABSTRACTS OF JAPAN vol. 018, no. 551 and computer-based translation of JP 06 203861 A appended in annex

D4: WO 00/39870 A

D5: US-B1-6 503 650

D6: US 2003/012986 A1

2) CLARITY:

2.1) The application does not meet the requirements of Article 6 PCT, because claim 14 is not clear.

2.2) The embodiments of the invention described in example 1 do not fall within the scope of the claims. This inconsistency between the claims and the description leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear, Article 6 PCT.

In the modified structure according to example 1 another catalyst layer of a noble metal or a noble metal alloy may be formed between the hydrogen permeable metal layer and the electrolyte layer whereas claim 1 gives the impression that the electrolyte layer is formed directly on the hydrogen permeable metal layer (cf. clarity objections for invention 1).

3) INVENTIVE STEP:

3.1) Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of claim 14 does not involve an inventive step in the sense of Article 33(3) PCT, and therefore the criteria of Article 33(1) PCT are not met.

3.2) Either one of document D1 (in particular column 26, line 57 - column 27, line 25) and document D2 (in particular claims 1, 11) is regarded as being the closest prior art to the subject-matter of claim 14, and insofar as this claim can be understood, each of these documents shows the following features thereof:

A fuel cell device comprising a fuel cell having a hydrogen permeable metal layer that is formed on a plane of an electrolyte layer that has proton conductivity and includes a

hydrogen permeable metal and further having another catalyst layer of a noble metal or a noble metal alloy formed between the hydrogen permeable metal layer and the electrolyte layer, said fuel cell device comprising

a temperature distribution portion to control an uneven temperature distribution in said fuel cells, due to temperature and flow direction of a reactive gas supplied to said fuel cells to be subjected to an electrochemical reaction.

The subject-matter of claim 14 therefore differs from this known fuel cell device in that the temperature distribution equalizing portion comprises

a first flow path and a second flow path to supply and discharge the reactive gas into and from said fuel cells;

a first switchover element that is provided in the first flow path to make a switchover between a gas intake state of allowing the reactive gas to be fed from a conduit connecting with the first flow path and to be introduced into said fuel cells and a gas discharge state of connecting the first flow path with outside to discharge the reactive gas flowed through said fuel cells to the outside; and

a second switchover element that is provided in the second flow path to make a switchover between the gas intake state of allowing the reactive gas to be fed from a conduit connecting with the second flow path and to be introduced into said fuel cells and the gas discharge state of connecting the second flow path with the outside to discharge the reactive gas flowed through said fuel cells to the outside,

wherein the first switchover element and the second switchover element are controlled to regulate the flow direction of the reactive gas passing through said fuel cells.

The problem to be solved by the present invention may therefore be regarded as to provide alternative means for equalizing the temperature distribution in a fuel cell device in particular in order to avoid degradation of fuel cell components due to e.g. temperature gradients or local heating in the fuel cell.

The solution proposed in claim 14 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons.

The above distinguishing feature is described e.g. in document D3 (claim 1; paragraphs 4,6,7,9,14,21) as providing the same advantages as in the present application. The skilled

person would therefore regard it as a normal design option to include this feature in the fuel cell device described in either document D1 or document D2 in order to solve the problem posed.

Similar as in document D3, documents D4 (page 24, line 31 - page 25, line 3), D5 (column 8, lines 36-38; column 10, lines 40-51) and D6 (paragraph 39) as well describe fuel cell devices having switchover elements for changing the flow direction of the reactant gases in order to equalize the temperature distribution in the fuel cell.

INVENTION III:

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1) Reference is made to the following documents:

D1: US-B1-6 444 339
D2: US-A-5 631 099
D7: DE 195 48 297 A1

2) CLARITY:

2.1) The application does not meet the requirements of Article 6 PCT, because claim 15 is not clear.

2.2) The embodiments of the invention described in example 1 do not fall within the scope of the claims. This inconsistency between the claims and the description leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear, Article 6 PCT.

In the modified structure according to example 1 another catalyst layer of a noble metal or a noble metal alloy may be formed between the hydrogen permeable metal layer and the electrolyte layer whereas claim 1 gives the impression that the electrolyte layer is formed directly on the hydrogen permeable metal layer (cf. clarity objections for invention 1).

3) INVENTIVE STEP:

3.1) Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of claim 15 does not involve an inventive step in the sense of Article 33(3) PCT, and therefore the criteria of Article 33(1) PCT are not met.

3.2) Either one of document D1 (in particular column 26, line 57 - column 27, line 25) and

document D2 (in particular claims 1,11) is regarded as being the closest prior art to the subject-matter of claim 14, and insofar as this claim can be understood, each of these documents shows the following features thereof:

A fuel cell device comprising a fuel cell having a hydrogen permeable metal layer that is formed on a plane of an electrolyte layer that has proton conductivity and includes a hydrogen permeable metal and further having another catalyst layer of a noble metal or a noble metal alloy formed between the hydrogen permeable metal layer and the electrolyte layer, said fuel cell device comprising

a temperature distribution portion to control an uneven temperature distribution in said fuel cells, due to either or both of temperature and flow direction of a reactive gas supplied to said fuel cells to be subjected to an electrochemical reaction and surroundings of said fuel cells.

The subject-matter of claim 15 therefore differs from this known fuel cell device in that the temperature distribution equalizing portion comprises

a reactive gas circulation module that recirculates at least part of a reactive gas exhaust, which is the reactive gas flowed through and discharged from said fuel cells, to the flow of the reactive gas; and

a reactive gas temperature decreasing module that decreases temperature of the reactive gas exhaust, prior to recirculation of the reactive gas exhaust to the flow of the reactive gas.

The problem to be solved by the present invention may therefore be regarded as to provide alternative means for equalizing the temperature distribution in a fuel cell device in particular in order to avoid degradation of fuel cell components due to e.g. temperature gradients or local heating in the fuel cell.

The solution proposed in claim 15 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons.

The above distinguishing feature is described e.g. in document D7 (claim 1; column 4, lines 55-61) as providing the same advantages as in the present application. The skilled person would therefore regard it as a normal design option to include this feature in the

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fuel cell device described in either document D1 or document D2 in order to solve the problem posed.